THE

NEVV ARTIFI-
CIAL GAVGING
LINE OR ROD:

Together with rules concerning
the use thereof:

Invented and written by WIL-
LIAM OVGHTRED.
who
In all due and respective observance
præsenteth the same

To the Right Honourable LL. Sir NICOLAS
RAINTON Lord *Major* of London for
this præsent yeare, and RALFE
FREEMAN Alderman Lord
Major elect for the yeare
now ensuing.
and
To the Worshipfull GEORGE ETHRAGE the
late Master, and *Captaine* IOHN MILLER
the præsent Master of the Company
of *Vinteners*.
And to the whole body of that Right
Worshipfull societie.

London Printed by *Aug. Mathewes.* 1633.

XIX.
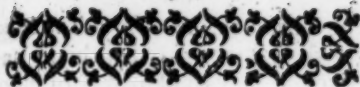
Right Honourable,
and
Right Worshipfull.

Doubt not, but as every worthy and laudable worke is subject to obloquie and ill construction: So this my good intent and usefull invention, which I here present unto you Right Honourable Lords, and you Right Worshipfull, into whose clienclie I betake both my selfe and it, shall meet with some over-curious and supercilious censurers, who will misse-judge and misse-say the same: though not for the art (against which I perswade my selfe they shall find little cause to except) yet in respect of my particular calling : of the height and dignity whereof, such small and low cogitations may seeme to be unworthy. But may it please them to consider,

A 2   that

that Theologie is *ἐπιστήμη μάλιστα ἡγεμονικὴ ἣ ἀρχιτεκτονικὴ*, the chiefe and principall Lady and Mistresse of all other faculties; unto which all callings in this life, for their just, faithfull, and conscionable execution, are to comply, and bee accountable. And seeing God in his sacred word biddeth not onely *cease to doe evill*, but also *learne to doe well, and seeke judgement*; that Divine may bee thought best to performe his dutie; that shall not onely reprove injustice and wrong dealing, but shall also even in particular actions informe the conscience both what is right, and how to performe it. This I have herein endeavoured to effect. The holy Scripture is frequent in shewing *the abomination of false and deceitfull weights*, and in forbidding *to doe unjustly in line, in weight, or in measure*; and telleth us that *a true weight, and a just balance are of the Lord*; and that *all the weights in the bagge are his worke*. If I therefore by the helpe of God, and the knowledge hee hath beene pleased to give me, shall exhibite

Esa.1.16.

Mic.6.11.
Lev.19.35.
Prov.16.11.

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bire unto this renowned Citie, a line and rule to measure vessels with according to true art, and shall teach how to reforme an errour, which hath for some time (through ignorance of better) usurped the place of truth; and that with much more facility, then it is committed : I hope I shall not justly be thought to wander out of the limits of my profession and calling. Now the occasion whereby I invented it was this.

Many yeares agoe, I devised for my private use an instrument, which I called *the Circles of proportion* : which is nothing else but *the Logarithmes of Numbers, Sines, and Tangents* set on circles. And I writ in latine the manifold uses thereof, not onely in *Arithmetical; Geometrical, and Astronomical calculations*, but also in divers other accounts, practises, and questions, which are occurrent in the civill societie and conversation of mankind : among which one was concerning *the measuring or Gauging*

of

of vessels : wherein taking the forme of them to be *sphæroide, or like a long sphære*, with the two ends equally cut off, (as generally both by the ancienter and later writers is supposed, and in the fabric of such vessels is still aymed at by the Makers) I delivered out of the grounds and inventions of that most admirable Artist *Archimedes*, the true and artificiall way of finding their severall contents : and applyed it unto the use of that my instrument, with as much ease and expeditnesse as I could. Neither did I at all discourse upon the Mechanicall wayes practised by other men, much lesse refute any of their errors, but onely barely and positively delivered the truth. These my notes, and that my instrument (after many yeares) at the perswasion of a friend of mine, who profered to translate them into English, I was content hee should set out and make common, my selfe not having any hand in that publication. When now the translation was ready for the Printer, my

<div align="right">friend</div>

friend having perused that which *Master Gunter* in his second booke of the *Croſſeſtaffe Chapt.* 4. writeth very obſcurely about Gauging of veſſels, asked mee what he meant by *the meane Diameter after the vſuall manner?* I anſwered him that in the vſuall manner of art there was no *medium* or meane, but the meane be-tweene the two extreme termes in ſome kind of Proportion : and that all proportion being either *Arithme-tical, Geometrical,* or *Muſical,* hee be-ing a Scholer and an Artiſt, muſt needs (as I thought) by the meane under-ſtand one of thoſe three : and moſt likely the meane arithmetical which is the greateſt of them. For ſuppo-ſing the two extreme termes to bee 9 and 4, betweene theſe the meane arithmetical is 6 ½, which is halfe the ſumme of both : the meane geome-trical is 6 : and the meane in muſical proportion is 5 ⁴⁄₁₃. And yet ſaid I, the meane arithmetical is too little, as in the menſuration of tapering timber I proved : much more either of the

two

two reſt. And other meane diameter, which may give the true content of a ſphæroides, art affordeth none. My friend replyed, Maſter *Gunter* is generally acknowledged to have bin a man of skill, and you utterly unknowne : and hee that ſhall find your booke, diſagreeing from his documents, will without any more adoe reject it; you ſhall therefore doe well to write in a few lines why you differ from Mr *Gunter*, and to ſhew that his way by the meane diameter cannot ſtand with art. Which his counſell I ſeeing not to be unneceſſary, eſpecially in regard of the great paines hee had taken in the tranſlation of my notes, tooke a pen, and preſently in the margine of his tranſlation writ that ſhort advertiſement touching Mr *Gunters* meane diameter.

Not long after that tranſlation was in print, word was ſent me into the countrey, that an old man (that ſaid he was) *the Gauger of London* came earneſtly inquiring after me, and was very angry ; profeſſing *hee would vindicate*

dicate

dicate Mr. Gunters credit, and speake
for him, that could not answer for him-
selfe: and that I had taught a false
way of Gauging vessels: and that both
hee and many others, had bought of my
bookes; which much troubled him:
and hee was very solicitous how they
should come by their money againe: and
that hee never saw such a booke in his
life; for he could not tell what to make
of it. The translator told him, that
when he, or any other for him, should
disprove that way of measuring
vessels, which I had delivered; let
him bring his booke, and he should
have his money againe for it.

At my next comming to London,
hee hearing of my being in towne,
came to mee, and expostulated with
me, why I would presume to question
any thing that Mr. Gunter writ?
I answered him, that it is a fault inci-
dent to the students of these arts, to
be very incredulous, especially if they
see demonstration to the contrary.
Hee said I understood not what Mr.
Gunter meant by the meane diameter
<div align="right">after</div>

after the vsuall manner : For Mr.
Gunter (though hee said not so much)
did understand the manner vsuall in
London; and that hee himselfe follow-
ed in gauging: which was to halfe the
summe of the diameters at the head and
bung, and to adde one quarter of their
difference : and that this was a true
way, and a better way then mine: and
that if hee should use my way, it would
require much more paines, and longer
time: and that hee had a man, whom
hee had taught, which had little or no
skill in Arithmetic, and could scarce
multiply, yet in his way hee should gauge
with any man in England; and that if
that his way were not right, hee might
doe more wrong in a few yeares then any
Aldermans state in London is worth;
and that hee was sworne to doe justly.
I answered, that the greater tye lay
upon him to doe justly, and the more
hurt hee might doe by misgauging,
the more thankes hee owed mee, for
shewing him the right; and with
the more gladnesse hee should em-
brace it, notwithstanding it might
have

have some more difficultie : for though I should hold my peace (as Mr. *Gunter* it seemeth did) yet hee were never the more justifiable : and wished him to looke to his conscience : especially seeing now hee might informe himselfe in the truth. Hee said *hee found indeed by his experience, that the adding of a quarter of the difference was somewhat too much ; and therefore that now hee began to take one fift part thereof : and yet both wayes were better then mine ; and hee would not learne of mee to gauge vessels.* And so went his way in great choler and displeasure. I did indeed wonder at that his assertion; that whether hee tooke the quarter, or the fift part of the difference , yet both are better then the way of art , which I had delivered : for even in that example , which in my booke is set downe, of a vessel having the diameter at the bung 32 inches, and the diameter at the head 18 inches , and the length 40 inches; had hee but made triall, hee should have found the

<div align="right">content</div>

content computed by one quarter of
the difference , to have beene gallons
110 and almost an halfe; and by one
fift part, to have beene gallons 105 $\frac{1}{2}$;
whereas the true measure by art is gal-
lons 107 and an halfe and somewhat
better; which is almost in the very
midst betweene both : so that if any
man will suppose one of his wayes,
bee it the former, or the latter, to bee
right : yet the other must of neces-
sitie bee further from the truth, then
that which I taught; because it fal-
ling betweene both , must needs bee
neerer to each , then one of them is
to the other.

Not long after M^r. *Elias Allen* (a
man well knowne and esteemed by
all men of art for his skilfulnesse in
making instruments in metal)being in
the company of some gentlemen of
good quality and worth, upon occasi-
on related these former words of the
Gauger, what great detriment hee
might doe by his manner of Gauging,
if it were not true. Which his speech
M^r. *George Ethrege*, then Master of
the

the right worshipfull Company of
Vinteners, hearing and observing, said
that indeed he doubted not, but there
was much wrong done by misgauging
wine vessels ; and that many times
they found it to their cost ; but they
could not easily remedy it. And there-
fore invited M^r. *Allen* to request me to
devise *a Ganging instrument*, which
might be according to true art, and of
familiar and easie performance; that
they might examine and try their
vessels themselves : and said it would
bee an invention very acceptable, and
of great use, and a meanes to prevent
much wrong that many times is done.
Which inquisition and studie, to find
out a true and perfect instrument for
measuring of vessels (though at first
without any hope of effecting any
singular thing therin after such a num-
ber of learned artists, and writers in
this kind, with the meanest of which
I am not to bee compared) I under-
tooke, merely out of my love to the
society of mankind, and my desire of
advancing truth and justice ; and at
last

last by the helpe of God, who is
righteous, and loveth righteousnesse,
have brought to passe : And herein
withall humble and affectionate ser-
viceablenesse, both unto you my *right
honourable LL.* upon whom the
principall care of all such admensura-
tions within this most flourishing
and illustrious Citie doth rest, and of
you *right worshipfull the Masters and
whole Company of Vintners*, and to as
many of this most renowned Citie as
shall have cause to use the same, I pre-
sent this my *new gauging instrument*.
Onely desiring thus much, that you
would be pleased to vouchsafe it your
acceptance with the same loving and
benevolent respect, as I my selfe had
unto you, and the truth, in the investi-
gation thereof.

The tryall
made of
this gan-
ging instru-
ment : and
the certain-
ty of it.

Neither indeed may I omit to re-
port the noble favour that *the right
worshipfull Company of Vintners* did
afford, though unknowne, unto mee.
For when Mr. *Elias Allen* had fini-
shed up one of those my *instruments*

or ganging rods, and had brought it
to their Hall, they presently deputed
certaine of their society to see the
experience and performance thereof,
at the Taverne by *Leaden-hall* under
the signe of the *Kings-head* : and
they tooke the paines to examine the
truth of it in many and sundry kinds
of wine vessels ; where, as I have
beene told (for I was not there present my selfe) beyond all expectation
they found such an exact agreement
with the measure of water they filled
in by gallons, after the sealed Standard
for wine measure, that in most the
difference was scarce sensible ; whereas the markes set thereupon exceeded
the same measures by two or three,
and sometimes more then foure gallons in a vessell. Whereupon they
agreed with Mr. *Allen* for a price,
and bespake of him threescore of the
same my *rods or instruments*. Which so
noble and courteous respect unto me,
to decree the examination of that
my invention (though other benefit or recompense for the same
I de-

I demand none) I cannot but acknowledge with much thankefulnesse.

The facilitie of working by this new rod, compared with the troublesomenesse of the other erroneous way.

Neither is the facilitie of working therewith any whit inferior to the certaintie of it : but even in measuring of vessels by this true rule much lesse paines is taken , then that other erroneous and inartificiall way doth necessarily require.

For therein *first the two diameters at the bung ; and at the head measured in ynches must be added together , and halfe the summe of them taken and kept.*

Secondly the diameter at the head is to bee subducted out of the diameter at the bung, and the remaines to bee divided by 4, or else by 5 , to find out the quarter , or fift part of their difference.

Thirdly that quarter or fift part of the difference must bee added to the halfe summe kept ; to make up a meane diameter.

Lastly there remaineth a proportion to bee wrought by multiplication and division ; which is this,

As

As the quadrate of 17|15 (which M^r
    Gunter calleth his gauge point) is
    to the quadrate of the meane
    diameter last found,
So is the length of the vessell measu-
    red in inches,
        to the content of the same vessell
        in wine gallons.

Such a deale of paines, and such a
multiplicitie of worke is undergone
in their ordinary gauging : and yet
when all is done, the capacitie or con-
tent of the vessell so found is merely
conjecturall , sometimes falser and
sometimes truer, according as the dia-
meters of the vessell are more or lesse
unequall.

But this way of art, which I pro-
pose, besides that it is constant and uni-
versall in all kinds of wine vessells,
is most easily performed only with
one single addition & multiplication,
as shall anon bee declared both by
rule, and examples. Soe that now I
hope I have made *M. Gauger* amends

for

or the too much difficultie and paines
hee thought my booke put him to;
and that henceforth hee will bee as
earnest to vindicate my credit also,
as hee hath egerly traduced it before
he rightly knew me. For although
I cannot so well excuse his rashnesse
in impertinent interposing himselfe in
questions hee had small skill in: yet
I perswade my selfe he had no malice
against my person, who was then ut-
terly unknowne to him. And for my
part (for ought I remember) I had
not so much as heard of any such offi-
cer about the Citie. But I wholly
impute his offence at me partly to the
high estimation hee had of Mr. *Gun-
ter*, from whom to dissent he thought
to be a hainous matter: and partly to
his diffidence and distrust of my rule,
how it might hold when it came to
tryal. And therefore I doe willingly
returne againe into favour with him,
and recommend this my invention
and my selfe to his future approbati-
on and friendship; assuring him that
what I have before written was not
                                    intended

intented against him : but onely to
shew the true occasion how I fell up-
on this search and disquisition: which
in regard of my profession seemed to
bee very necessary.

The principles whereon the way
that I teach is grounded, are these
two. First that a wine vessell is in
forme of a perfect sphæroide with
the two ends equally cut off. The
truth of which ground appeareth
both by the generall consent of almost
all who have written of gauging :
and by the fabric of such kind of
vessels ; which by the workemen and
makers thereof (so farreforth as in
practise they are able) are intended to
bee such. And now lately by tryal
made thereof with the Standard,
whereunto it is found to hold greater
correspondence in all kind of those
vessels, then could bee hoped for, or
almost imagined.

Secondly, that a *sphære, or sphæroide*
containeth two third parts of *a cylin-
der* having the same length and thick-
nesse ; and consequently that the so-

Two prin-
ciples or
grounds of
this gau-
ging instru-
ment.

lid convexitie betweene two *cylinders*, one within the *sphæroide*, and the other without touching it, and having the same center and height, is equall to two third parts of the difference of those two *cylinders*: which hath long since beene taught by the ancient *Siracusan Archimedes* in his first booke of *the Sphare and Cylinder*, & in his booke of *Cone-like and sphere-like* magnitudes: & of late by our English *Archimedes* Mr *Henry Briggs*, in his Treatice of *Arithmetica logarithmica*.

Out of the consideration of these two principles, or grounds, I framed my rule, which I set downe in my booke of *the Circles of proportion*, Chapt.9. in these words. *Measure the two diameters of the vessell, in inches, or else in tenth parts of a foot, the one at the bung hole, the other at the head, and also the length within. And by the diameters found, find out the circles; then adde together two third parts, of the greater circle, and one thir*

The rule of Gauging framed out of those two grounds.

third part of the leſſe ; Laſtly , multiply the aggregate by the length : ſo ſhall you have the content of the veſſell, either in cubic ynches , or cubic tenth parts of a foot. Which afterward in the end of that Chapter (having firſt inquired the quantity of a gallon both Ale, and Wine meaſure in ſolid ynches, the one to bee 272 $\frac{1}{4}$ the other 231) I taught how to reduce into gallons and hundreth parts, by dividing the whole number of ynches contained in the veſſell by either of thoſe two numbers reſpectively. And this is that very rule, the worke and practice of which I have by art, with an invention not yet thought upon by any other, and with diviſions calculated for that purpoſe, fitted and applyed to this my *new ganging line or rod.*

It conſiſteth of *two rulers of braſſe* about 32 ynches of length, which alſo are halfe an ynch broad, and a quarter of an ynch thick : that being ſet together they may make halfe an ynch ſquare.

The gauging rod deſcribed : and of the ſeverall parts thereof.

At

At one end of both those rulers are
two little sockets of brasse fastned on
strongly : by which the rulers are
held together, and made to move one
upon another, and to bee drawne out
unto any length, as occasion shall re-
quire : and when you have them at
the just length, there is upon one of
the sockers *a long Scrue-pin* to scrue
them fast.

These two little sockets encom-
passe not both rulers quite round : but
have each of them *a slit about a quar-
ter of an ynch board* : that they may
not hinder the sight of the divisions,
which are upon the broad or flat sides
of the rulers. Which divisions are
indeed of most principall use : being
properly the *gauge-divisions* : and are
now first of all invented, and accom-
modated to the mensuration of
vessels.

The *gauge-divisions* are in all two
hundred and thirtie : of which eve-
ry particular division standeth for
one hundreth part of a wine gallon:
so that they are in all 2 wine gallons
and

and 3 hundred parts. And for the more perspicuous distinguishing of them they are figured by tens thus,
0|10, 0|20, 0|30, 0|40, 0|50, 0|60, 0|70, 0|80, 0|90, 1|00, 1|10, 1|20, 1|30, 1|40, 1|50, 1|60, 1|70, 1|80, 1|90, 2|00, 2|10, 2|20, 2|30 : there being betweene every one of those figures ten divisions, or ten hundreth parts.

At the other end of both the rulers is *a hooke framed into right or square angles* to be scrued on: the one with a *Scrue-pin*, the other with *a matrix or Scrue-plate*. And above these hookes the edge of both rulers is divided into ynches, beginning exactly equall with the ends of the hookes: and figured with 5, 10, 15, 20, 25, 27, 30, &c. And each ynch is subdivided into ten equall parts. Which division of ynches, together with the hookes, serve to take the length of all vessels; that the ends of the barrell boards overreaching the bottoms, may not bee an impediment to the measuring thereof.

Vpon the other edge of each ruler

is set the *the line of Numbers* : which
is the very same in both: though some
what differently figured. For that on
the ruler next the *socket with the
long Scrue-pin*, is noted with the fi-
gures 1,2,3,4,5,6,7,8,9,10,20,which
I therefore call *the line of digit num-
bers*: and that on the other ruler is
figured with tens, as 10,20,30,40,50,
60, 70, 80,90, 100, 200, 300 : and I
call it *the line of denarie numbers*.
Wherein you are to remember tha
from 1 to 5, and from 10 to 50, andt
also above 100 , every space is subdi-
vided into one hundred parts , but a-
bove 5 unto 10 , and above 50 unto
100, because the spaces are too small
to receive an hundred parts , they are
subdivided but into fiftie.

The use of
the gauging
tod taught
in foure
rules.

Thus having shewed the descrip-
tion of the severall parts of *the gau-
ging rod* : I now come to the use
thereof in measuring any kind of
vessel by the wine gallon. For which
I will set downe these fower rules,

Rule I.

Rule I. *How to take the length of a Vessell.*

HAving first fitted the two hookes upon the ends of the two rulers, so that the line of ynches may be uppermost, draw out the rulers in length, and apply them to the vessell long wise, so that the two hookes may embrace the two bottoms thereof: at that length scrue them fast together with the long Scrue-pin in the socket: then take off the hooke, which hath the Scrue-pin: and looke how many ynches the socket of the ruler which hath the hooke on doth cut in the ruler without the hooke: for that shall be the length of the vessell from out side to out side in ynches: wherefore if out of that measure you take the thicknes of the two bottoms (which may bee easily estimated by a spigot hole) you shall have the true length of the vessell within.

But if the length of the vessell be

lesse then 27 ynches, you cannot use
both hookes, as before was done.
Wherefore apply the ruler which
hath the matrix or Scrue-plate to the
vessell, setting that hooke against one
of the bottoms: and where the divi-
sions of ynches in that ruler begin-
neth, stick up a knife: then remove
that same hooke to the other bot-
tome; and the ynches, which the
knife cutteth, shall give the length of
the vessell from out side to outside.

Rule II. *How to take the Diameters*
of a Vessell at the Bunge, and at the
Head, and how to adde them toge-
ther, that you may finde the summe
of them.

THe Diameters are not measured
by ynches, as the length is, but by
Wine gallons, and hundreth parts: in
this maner. Take off the hook which
hath the scrue-pinne, and dipp that
end of the Ruler into the Vessell at
the bung; and looke how many parts
of the divisions of Gallons t he inside
of

of the bung-hole doth cut, the same
shall bee the Diameter at the bung.
In like maner apply the same end of
the Ruler to the head of the Veſſell
without; and looke how many parts
of the diviſions of Gallons it is broad
over the midd'ſt or center thereof;
the same shall be the Diameter at the
head.

But if the Diameter at the bung be
greater then that Ruler is long: draw
out the rulers, and ſerue them at their
whole length: and ſo meaſure there-
with the Diameters, as was before
shewed.

The two Diameters being found
out muſt bee added together, thus:
Write downe the Diameter at the
bung twice, and under it the Diame-
ter at the head onely once, ſetting like
places one under another in the ſame
rowes: that is all the unites in one
rowe; all the tenth parts (which are
they next the units) in another
row; and all the hundreth parts in
the laſt row: and draw a long line be-
tweene the unites and the parts, then
                                        adde

adde them all three together into one
summe by the way of ordinary Addi-
tion. As in example ; Suppose a Vef-
fel that hath the diameter at the bung
gallon 1 & 8 hundreth parts, *viz.* 1|08 ;
and the diameter at the head onely 96
hundreth parts of a Gallon, *viz.* 0|96 .

you shall write downe
the Diameter at the
bung twice, & the dia-
meter at the head once
and adde them altoge-

1|08
1|08
0|96
3|12

ther, as you see done in the side: and
the summe of the diameters shall bee
found 3|12, that is gallons 3 and 12
hundreth parts. And thus shall you
doe in all Vessels.

Rule III. *How to multiply the summe
of the Diameters of a Vessell by the
length.*

THe length of a Vessell being mea-
sured in ynches and tenth parts,
and the Diameters being found out in
Gallons and hundreth parts, and also
added together, as hath beene decla-
red

red: The summe of the Diameters
is to bee reconed in the line of digit
numbers, which is noted with the
figures 1,2,3,4,5, &c. and the length,
in the other line of denarie numbers,
which is noted with the figures 10,
20,30,40,50,&c. In both which lines
of numbers you are to confider, that
in the spaces betweene the figures e-
very tenth division is diftinguifhed
with a long line: and every fingle di-
vifion with a fhort line: and every
fift with a line of a length betweene
both. and in the line of digit num-
bers, they fignifie fo many hundreth
parts of a gallon: But in the line of
denarie numbers (as alfo in the line of
digit numbers beyond 10) every tenth
division is for unites; and every fin-
gle division is for tenth parts. and
beyond 100 every tenth division is
for ten; and every fingle division for
one unite. Where note, that in thofe
spaces, which by reafon of their fmal-
neffe have but 50, yet they are under-
ftood to bee 100, by imagining every
one to containe two.

The

The nature and valuation of both
the lines of numbers, the digit and
the denarie, being understood, mul-
tiplication is thus to be wrought. Set
the unite place of the line of digit
numbers marked with 1, to the place
of the length of the Vessell reconed
in the line of denary numbers: there
serue the Rulers fast. then in the line
of digit numbers recon the summe of
the Diameters found out, that at the
Bung being doubled, as was taught
before: and looke what space and
diuision it poynteth out in the line of
denary numbers: the same being rea-
sonably æstimated, shall bee the pro-
duct sought for.

By æstimating reasonably I under-
stand that you consider whether the
figure of that space is to bee taken for
tenns or for hundreds: which is done
very easily: for no man is so simple,
as to mistake a Vessell of ten or twen-
ty Gallons, for one or two hundred;
or of one or two hundred gallons, for
one of ten or twenty. And yet this
short rule may bee given. That the
                                    product

product is to bee estimated according
to that former valuation of the line of
denarie numbers: unlesse the Vessell
be so small, that the summe of the
diameters amount not to one gallon:
for then the figures 100 & 200, are
to be taken for 10 and twenty.

And if at any time it chance, that
the summe of the diameters falleth
not betweene the unite place in the
line of digit numbers, and the socket:
divide the same summe by 2, and then
multiply the one halfe by the length;
so shall you have halfe the product
sought for: which being doubled will
give you the whole.

Rule IIII. *How to gauge or measure
the content of any Vessell in Wine
gallons.*

TAke the length of the Vessell pro-
posed in ynch-measure, according
to the *Rule* I, then take the two di-
ameters in gallon measure, and adde
them together, that at the bung being
doubled, according to the *Rule* II.
Lastly

Lastly multiply the summe of the diameters by the length, according to *Rule* III: and the product being reasonably æstimated, shall give the number of Wine gallons contained in that Vessell.

The performance and practice of this Worke by Examples.

Example I.

Diverse examples shewing the use of this Instrument, and the practice of the former rules.

ANd first I will take the Example in my booke of the *Circles of Proportion*, *Chap 9*, of a Vessell supposed to bee in length 40 ynches; and the diameter at the bung 32 ynches; and the diameter at the head 18 ynches: which two diameters being taken with my gauging rod in gallon measure, would have beene at the bung gallons 1 and 16 hundreth parts, and at the head almost 37 hundreth parts of a gallon. Set downe the diameter at the bung twice, and the diameter at the head once; & adde them: the summe of the

diameters shall be gallons 2 & almost 59 hundreth parts, by *Rule* II. which being multiplyed by 40, the product shal be gallons 107, and better then an halfe; which is the true content sought for.

	1|16
	1|16
	0|37-
	2|69-

Example II. Suppose a small Vessell; whose length is ynches 45 and 3 tenth parts, *viz.* 45|3 ; and the diameter at the bung 38 hundreth parts of a gallon ; and the diameter at the head 30 hundreth parts. what is the content ?

Adde the two diameters together, that at the bung being doubled, the summe is gallons 1 and 6 hundreth

	0|38
	0|38
	0|30
	1|06

parts, by *Rule* II. Multiply this summe by the length 45|3 : and the product shall bee 48|12- by *Rule* III, that is gallons 48 and almost 12 hundreth parts : which is the true content sought for.

C   *Exam-*

Exam. III. Suppose another small vessel, whose length is ynches 30 and 7 tenth parts, *viz.* 30,7. and the diameter at the bung 34 hundreth parts of a gallon: and the diameter at the head 28 hundreth parts. what is the content?

Adde the two diameters together, that at the bung being doubled: the summe is onely 96 hundreth parts of a gallon,   0|34
by *Rule* II. Multiply   0|34
this summe by the   0|28
length 30,7 : and the   0|96
product shall be 29,47,
by *Rule* III, that is gallons 29, and 47 hundreth parts, which is almost an halfe. which is the true content. For the first figure 2 signifyeth not 200 (though it be so marked on the line of denarie numbers) but only 20; as both plaine reason, & also the short rule, at the end of *Rule* III, wil shew.

Exam. IIII. Suppose a great vessel: whose length is ynches 70 and an halfe, *viz.* 70,5 ; and the diameter

er at the bung gallons 2 and 3 hundreth parts, *viz*, 2|03 ; and the diameter at the head gallons 1 and 10 hundreth parts, *viz*. 1|10 . what is the content ?

Adde the two diameters together, that at the bung being doubled ; the summe is gallons 5 and 16 hundreth parts, by *Rule* II. Multiply this summe by the length 70|5 : but becaufe the units place of the line of digit numbers, being

```
             2|0 3
             2|0 3
             1|10
          2) 5|16
             2|5 8
```

set to 70|5 in the line of denarie numbers, the summe of the diameters 5|16 will over-reach beyond the socket : therefore to helpe this, take halfe the summe of the diameters, *viz*. gallons 2|58 : and multiply that halfe summe by the length 70|5 : and the product shall bee 181|89 , by *Rule* III , that is gallons 181 and almost 9 tenth parts : which is halfe the true content. And being doubled shall give gallons 363|78 for the whole content of that great vessell.

C 2.   The

The Examples following are of some veſſels meaſured in the preſence of them, which were deputed by the Company of Vinteners to ſee the try-all of this Gauging line or rod.

Exam. V. A Canarie pipe whoſe length was ynches 48 and an halfe, *viz.* 48.5 ; and the diameter at the bung 93 hundreth parts of a gallon, *viz.* 0.93 : and the diameter at the head 54 hundreth parts , *viz.* 0.54. what is the content?

Adde the two diameters together, that at the bung being doubled, the ſumme is gallons 2 and 4 tenth parts, by *Rule* II. Multiply this ſumme by the length 48.5 : and the product ſhall bee 116.4 by *Rule* III, that is gallons 116 & 4 tenth parts : which is the content ſought for.

$$
\begin{array}{r}
6|93 \\
0|93 \\
0|54 \\
\hline
2|40
\end{array}
$$

Examp. VI. A Graves-hogſhead whoſe length was ynches 31 and 2 tenth parts, *viz.* 31.2 : And the diameter at the bung 73 hundreth parts of a gallon , *viz.* 0.73 ; and the diameter

meter at the head 57 hundreth parts,
viz. 0,57. What is the content?

Adde the two dia-   0|73
meters together, that   0|73
at the bung being   0|57
doubled, the Summe   2|0.
is gallon 2 and 3 hun-
dreth parts, by Rule I I. Multiply
this summe by the length 31,2 : and
the product shall bee 63,34 by Rule
III, that is gallons 63 and 34 hun-
dreth parts : which is the content
sought for.

Example VII. A High-countrey
hogshead whose length was ynches
30, and 8 2 hundreth parts, *viz.* 30,82 :
And the diameter at the bung 63 hun-
dreth parts of a gallon : *viz.* 0,63 and
the diameter at the head 51 hundreth
parts, *viz.* 0,51. What is the con-
tent?

Adde the two diame-   0|63
ters together, that at   0|63
the bung being doub-   0|51
led, the summe is gal-   1|77
lons 1 and 77 hun-

C 3   dreth

dreth parts, by Rule II. Multiply this
summe by the length 30.82 : and the
product shall bee 54155, by Rule III,
that is gallons 54 and 55 hundreth
parts : which is the true content
sought for.

<div style="display:flex">
<div style="font-style:italic">The use of
this Instru-
ment in
gauging
beere vessels.</div>

Although this Gauging instrument
is properly framed for measuring
vessels by the wine gallon : yet it
may also fitly be applyed to the mea-
suring of the same vessels by the ale
or beere gallon. And for this pur-
pose I have on the Ruler figured
with digit numbers set two little
lines or markes, the one at 272½, no-
ted with the letter (w) ; and the o-
ther at 231, noted with the letter (a).
The use of which I deliver in this
Rule following.
</div>

*Seeke out the content of the vessell
proposed in wine gallons, upon the ruler
figured with denarie numbers, as hath
before beene taught: and thereto set
the marke (w): and so shall the other
marke (a) point to the number of beere
gallons contained in the same vessell.*

I will

I will fhew the practice of this Rule by the veffells meafured in the three laft examples.

Firft The Canarie pipe, whofe length was ynches 48,5 : and the diameter at the bung gallon 0,93 : and the diameter at the head gallon 0,54 : the meafure whereof was by Example V found to be gallons 116,4 : how many beere gallons will it containe?

Set the marke (w) unto the wine meafure 116,4 reconed upon the ruler figured with denarie numbers, fcruing it there faft, and the marke (4) fhall in the fame ruler point out 98,76 that is gallons 98 and 76 hundreth parts, the content thereof in beere meafure.

Againe, The Graves hogfhead, whofe length was ynches 31,12 : and the diameter at the bung gallon 0,73 : and the diameter at the head gallon 0,57 : the meafure whereof was by Example VI found to bee gallons 63,14 : how many beere gallons will it containe?

Set the marke (w) unto the wine
C 4   mea-

measure 63¦34 reconed upon the ruler figured with denarie numbers, scruing it there fast: and the marke (*a*) shall in the same Ruler point out 53¦74, that is gallons 53, and 74 hundreth parts, the content thereof in beere measure.

Lastly the High countrey hogeshead, whose length was ynches 30¦81: and the diameter at the bung gallon 0¦63: and the diameter at the head gallon 0¦51: the measure whereof was by Example VII found to bee gallons 54¦55: how many beere gallons will it containe?

Set the marke (*w*) unto the wine measure 54¦55 reconed upon the ruler figured with denarie numbers, scruing it there fast: and the marke (*a*) shall in the same ruler point out 46¦28, that is gallons 46, and 28 hundreth parts, the content thereof in beere measure.

: And

And now I have finished what I
determined to write concerning the
use of this my *new Gauging line or
rod*: and have made it so plaine and
easie that I doubt not but every
meane capacitie will bee able with a
little care to apprehend the meaning
and practice : I have also delivered
the *Rule* which I follo*w*, and where-
upon I ground this worke : only the
maner of computing the *Gauge-divi-
sions* I have concealed : both because
that speculation is impertinent to the
managing and hand-working there-
with : and also that because unto
men of art by comparing the rule
with the performance, it will not bee
difficult to find out the reason : but
especially because I intend and wish
the benefit of making and fabricating
this Instrument, unto M^r. *Elias Allen*,
who gave the occasion of it, and at
whose request I invented it.   And
if it shall bee serviceable to this most
illustrious Citie, as a meanes of kee-
ping truth and equitie in that kind,
and acceptable to you Right Honou-
                                            rable

rable LL and to you Right Worship-
full to whom I present it, and con-
ducing unto the glory of Al-
mighty God, the author of
every good abilitie, it hath
obtayned the desired

END.

Addition		the summe or aggregate.
Subduction	findeth out	the remaines or difference
Multiplicŏn		the product or rectangle.
Diuision		the quotient.

( )

PErlegi hoc opus *Mathematicum*,
cui titulus est, The new artifici-
all Gauging Line or Rod, *in quo
nihil reperio quod non cum utilitate
publica imprimatur, modò intra tres
menses proximè sequentes Typis manda-
detur.*

Ex ædibus Lambethanis,
Octob. 10.
1633.

Guil. Bray.

These Instruments are made in brasse by *Elias Allen* over against St. *Clements* Church without Temple-barre : where also those who are desirous may bee instructed in the practicall use thereof : and such as shall have occasion may have vessels gauged.

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